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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 09/730,561	Applicant(s) SUZUKI ET AL.	
	Examiner James A Thompson	Art Unit 2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-74* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-74* is/are rejected.

7)☒ Claim(s) *27* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 December 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 09/324507.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). The certified copy has been filed in parent Application No. 09/324507, filed on 3 June 1999.

Claim Objections

2. Claim 27 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. The limitations recited in claim 27 are recited in lines 5-7 of claim 24, upon which claim 27 depends.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 36-38 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the

invention. Claims 36-38 disclose an apparatus which performs the steps of “providing” and “generating” without disclosing the means or elements of the apparatus which perform the steps of “providing” and “generating”. The lack of disclosure of the means or elements of the apparatus which perform said steps therefore renders claims 36-38 non-enabling.

5. Claims 39-41 rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 39 discloses an apparatus which performs the steps of “generating” and “composing” without disclosing the means or elements of the apparatus which perform the steps of “generating” and “composing”. The lack of disclosure of the means or elements of the apparatus which perform said steps therefore renders claims 39-41 non-enabling.

6. Claims 72-74 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 72 discloses that “a dot pattern generated by the threshold matrix has an anisotropy spectrum having an average value of 3 dB or more and a maximum value

of 10 dB or more at each respective gray level." However, Applicant does not disclose how the apparatus of claim 72 generates said dot pattern with those properties. For example, the basic structure of the threshold matrix is not disclosed. For a further example, the elements or means comprising the apparatus that cause the apparatus to generate said dot pattern are not disclosed. It would require undue experimentation for one of ordinary skill in the art to make and/or use the invention disclosed in claims 72-74.

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1-8, 26, 35-36, 42-44 and 52-54 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 26, 36, 42 and 52 each disclose a "mask of a size corresponding to a size smaller or substantially smaller than the standard size of the pixel block." The language is indefinite since "smaller" refers to anything that is smaller than the standard size by any amount and "substantially smaller" refers to a size that is smaller than the standard size by more than just a tiny amount. The language of claims 1, 26, 36, 42 and 52 therefore do not particularly point out and distinctly claim the subject matter which applicant regards as the invention.

9. Claims 1-23, 28-30, 35-38, 42-47, 52-54, 62-67 and 72-74 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 9, 16, 36, 37, 38 and 45 each disclose "generating, in the output image, no visually unpleasing artifacts"; claims 42, 52, 62, 65 and 72 each disclose that "visually unpleasing artifacts are not generated"; and claim 28 discloses that "the output image has no visually unpleasing artifacts". However, "visually unpleasing artifacts" is a subjective term. Each individual viewer views a computer generated image differently based on the precise way in which said viewer's eyes and brain detects and processes individual signals. Different viewers have different sensitivities to different artifacts. For a particular artifact, a small amount of the artifact may be considered visually unpleasing for one viewer, but hardly noticeable by another viewer. Therefore, claims 1-23, 28-30, 35-38, 42-47, 52-54, 62-67 and 72-74 fail to particularly point out and distinctly claims the subject matter which applicant regards as the invention.

10. Claims 24-35, 39-41, 50-51 and 60-61 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 24 recites the limitation "the dispersed-dot dithering method" in line 7 of claim 24. There is insufficient antecedent basis for this limitation in the claim.

Claim 39 recites the limitation "the dispersed-dot dithering method" in line 7 of claim 39. There is insufficient antecedent basis for this limitation in the claim.

Claim 50 recites the limitation "the dispersed-dot dithering method" in line 15 of claim 50. There is insufficient antecedent basis for this limitation in the claim.

Claim 60 recites the limitation "the dispersed-dot dithering method" in line 5 of claim 60. There is insufficient antecedent basis for this limitation in the claim.

11. Claims 72-74 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 72 discloses that "a dot pattern generated by the threshold matrix has an anisotropy spectrum having an average value of 3 dB or more and a maximum value of 10 dB or more at each respective gray level," but does not point out and distinctly claim the means by which said dot pattern is generated. Said dot pattern could be generated in a plurality of different ways that do not pertain to the claimed invention or to the subject matter addressed in the specification. Claims 72-74 therefore fail to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. Claims 16, 19-21, 23/16, 23/19-23/21 and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by Tajima (US Patent 5,572,600).

The apparatus of claim 38 performs the method of claim 16. Claims 16 and 38 are therefore discussed together.

Regarding claims 16 and 38: Tajima discloses an apparatus (figure 2 of Tajima) providing a plurality of isolated spectra for a two-dimensional spatial frequency spectrum (column 6, lines 26-34 of Tajima) of a dot pattern generated by the single mask (figure 6 and column 6, lines 6-11 of Tajima). Each isolated spectra of the two-dimensional spatial frequency spectrum is located in $\mu-\nu$ space at points corresponding to m and n equal to integers (column 6, lines 26-28 of Tajima) based on a conversion equation (column 6, equation 5 of Tajima). The equation is used in determining the screen angle for ideal Moiré conditions of a mask (column 6, lines 11 of Tajima). Since halftoning is performed for multivalued image data (column 5, lines 14-19 of Tajima), said plurality of isolated spectra are provided at each respective gray level.

Said apparatus generates, in the output image, no visually unpleasing artifacts, when the input image undergoes the gray level reproducing process (column 9, lines 48-54 of Tajima) and the image is output by an output device (column 10, lines 5-8 of Tajima). Said apparatus reduces Moiré (column 9, lines 48-54 of Tajima), which is well-known to be a visually unpleasing artifact in grayscale and color printing, and outputs the threshold values in synchronism with the multi-valued image data (column 10, lines 5-8 of Tajima), which would thus produce the output image.

Regarding claim 19: Tajima discloses that said artifacts include moiré and/or a certain repetitive pattern both having visually unpleasing contrast (column 9, lines 48-54 of Tajima).

Regarding claim 20: Tajima discloses that adjacent masks (figure 3(502M) of Tajima) are shifted along boundaries when said mask is repeatedly used and arranged two-dimensionally (figure 3 and column 5, lines 51-58 of Tajima).

Regarding claim 21: Tajima discloses a mask (halftone screen) (figure 3(502M) and column 8, lines 38-42 of Tajima) which is clearly not a quadrilateral.

Regarding claims 23/16, 23/19, 23/20 and 23/21: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 9, 11-13, 15/9, 15/11-15/13, 37, 45, 47, 55, 57, 65 and 67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660).

The apparatus of claim 45 performs the method of claim 9. The apparatus of claim 37 is embodied in the apparatus of claim 45. Claims 9, 37 and 45 are therefore discussed together.

Claims 11, 47, 57 and 67 disclose the same limitations and are therefore discussed together.

Regarding claims 9, 37 and 45: Tajima discloses an apparatus (figure 2 of Tajima) comprising storage means (figure 2(6M) of Tajima) for storing the threshold matrix (column 5, lines 30-34 of Tajima); comparison means (figure 2(5) of Tajima) for comparing each value of the threshold matrix with density of each pixel of the input image (column 5, lines 14-19 of Tajima). A binary or multivalue dot pattern is output (column 5, lines 18-19 of Tajima) based on comparison results of said comparison means (column 5, lines 14-19 of Tajima), therefore an output means must be included in the apparatus.

Said threshold matrix produces, by itself, the dot pattern having halftone screen (meshing) properties at each respective gray level (column 12, lines 54-59 of Tajima). Using the mask over the entire pixel block generates a smooth gradation (column 12, lines 54-59 of Tajima) and reduces Moiré (column 9, lines 48-54 of Tajima). Said threshold matrix generates, in the output image, no visually unpleasing artifacts, when the input image undergoes the gray level reproducing process (column 9, lines 48-54 of Tajima) and the image is output by an output device (column 10, lines 5-8 of Tajima). Said apparatus reduces Moiré (column 9, lines 48-54 of Tajima) and outputs the

threshold values in synchronism with the multi-valued image data (column 10, lines 5-8 of Tajima), which would thus produce the output image.

Tajima does not disclose expressly that said properties that are provided are non-blue noise properties.

Kolpatzik discloses providing stochastic properties to the threshold matrix (array) values (column 6, lines 35-37 of Kolpatzik). The stochastic properties of the stochastic threshold matrix are designed based on trade-offs between grain and mottle of the resultant image (column 6, lines 58-62 of Kolpatzik), and therefore not blue noise properties.

Tajima and Kolpatzik are combinable because they are from the same field of endeavor, namely halftone screen generation. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to add the stochastic screen properties taught by Kolpatzik to the halftone screen taught by Tajima. The motivation for doing so would have been to prevent image artifacts (column 7, lines 40-41 of Kolpatzik). Therefore, it would have been obvious to combine Kolpatzik with Tajima to obtain the invention as specified in claims 9, 37 and 45.

Regarding claim 55: The threshold matrix of claim 55 is embodied in the apparatus of claim 45, the arguments of which are incorporated herein.

Regarding claim 65: Tajima discloses an apparatus (figure 2 of Tajima) comprising digital memory (figure 2(3M,3C,3Y,6M,6C,6Y) of Tajima) and a digital control circuit (figure 2(4) of Tajima) that controls digital image data processing (column 4, lines 61-64 and column 5, lines 10-19 of Tajima). The apparatus is therefore a form

of computer. Since digital data is compared with threshold values (column 5, lines 14-19 of Tajima) and various digital processing is performed (column 6, lines 10-26 of Tajima), some form of software is required.

Said apparatus comprises a threshold matrix which produces a dot pattern, as disclosed in claim 55, the arguments of which are incorporated herein. Said apparatus further comprises a module for comparing (figure 2(5) of Tajima) each value of the threshold matrix with the density of each pixel of the input image (column 5, lines 14-18 of Tajima), and for controlling an output of each binary or multivalue dot pattern depending on the comparison results (column 5, lines 18-19 of Tajima).

Regarding claims 11, 47, 57 and 67: Tajima discloses that said artifacts include moiré and/or a certain repetitive pattern both having visually unpleasing contrast (column 9, lines 48-54 of Tajima).

Regarding claim 12: Tajima discloses that adjacent masks (figure 3(502M) of Tajima) are shifted along boundaries when said mask is repeatedly used and arranged two-dimensionally (figure 3 and column 5, lines 51-58 of Tajima).

Regarding claim 13: Tajima discloses a mask (halftone screen) (figure 3(502M) and column 8, lines 38-42 of Tajima) which is clearly not a quadrilateral.

Regarding claims 15/9, 15/11, 15/12 and 15/13: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

16. Claims 14 and 15/14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660) and Barton (US Patent 5,526,438).

Regarding claim 14: Tajima in view of Kolpatzik does not disclose expressly that, as a process of determining a dot distribution at each respective gray level for producing said mask, a repulsive potential is assigned to all dots constructing a determined dot pattern of a specific gray level and a new dot to determine a dot distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials.

Barton discloses a repulsive potential (FnC) that is assigned to all dots constructing a determined dot pattern of a specific gray level (column 8, lines 45-51 of Barton) and a new dot to determine a dot distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials (column 8, lines 50-55 of Barton). For a new dot about to be placed, a cost function (FnC) is determined (column 8, lines 45-51 of Barton). Said cost function is a function of radial distance (column 8, lines 48-50 and lines 64-66 of Barton) relating candidate pixels to other dots (column 8, lines 51-54 of Barton), so said cost function is a potential function.

Tajima in view of Kolpatzik is combinable with Barton because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the repulsive potential formulation of Barton to determine the dot locations for the threshold masks.

The motivation for doing so would have been to maximize dispersion and minimize visual artifacts (column 2, lines 50-53 of Barton). Therefore, it would have been obvious to combine Barton with Tajima in view of Kolpatzik to obtain the invention as specified in claim 14.

Regarding claim 15/14: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

17. Claims 18 and 23/18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Rylander (US Patent 5,583,660).

Regarding claim 18: Tajima does not disclose expressly that said output device has a resolution of 600 dpi or greater.

Rylander discloses an output device that has a resolution of 600 dpi or greater (column 12, lines 61-63 of Rylander).

Tajima and Rylander are combinable because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a high resolution output device, as taught by Rylander, to output the image data. The motivation for doing so would have been to output image data produced using a particular fixed pattern (column 12, lines 57-60 of Rylander). Therefore, it would have been obvious to combine Rylander with Tajima to obtain the invention as specified in claim 18.

Regarding claim 23/18: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

18. Claims 22 and 23/22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Barton (US Patent 5,526,438).

Regarding claim 22: Tajima does not disclose expressly that, as a process of determining a dot distribution at each respective gray level for producing said mask, a repulsive potential is assigned to all dots constructing a determined dot pattern of a specific gray level and a new dot to determine a dot distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials.

Barton discloses a repulsive potential (FnC) that is assigned to all dots constructing a determined dot pattern of a specific gray level (column 8, lines 45-51 of Barton) and a new dot to determine a dot distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials (column 8, lines 50-55 of Barton). For a new dot about to be placed, a cost function (FnC) is determined (column 8, lines 45-51 of Barton). Said cost function is a function of radial distance (column 8, lines 48-50 and lines 64-66 of Barton) relating candidate pixels to other dots (column 8, lines 51-54 of Barton), so said cost function is a potential function.

Tajima and Barton are combinable because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the repulsive potential formulation of Barton to determine the dot locations for the threshold masks. The motivation for doing so would have been to maximize dispersion and minimize visual artifacts (column 2, lines 50-53 of Barton). Therefore, it would have been obvious to combine Barton with Tajima to obtain the invention as specified in claim 22.

Regarding claim 23/22: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

19. Claims 10, 15/10, 46, 56 and 66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660) and Rylander (US Patent 5,583,660).

Claims 10, 46, 56 and 66 disclose the same limitations and are therefore discussed together.

Regarding claims 10, 46, 56 and 66: Tajima in view of Kolpatzik does not disclose expressly that said output device has a resolution of 600 dpi or greater.

Rylander discloses an output device that has a resolution of 600 dpi or greater (column 12, lines 61-63 of Rylander).

Tajima in view of Kolpatzik is combinable with Rylander because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a high resolution output device, as taught by Rylander, to output the image data. The motivation for doing so would have been to output image data produced using a particular fixed pattern (column 12, lines 57-60 of Rylander). Therefore, it would have been obvious to combine Rylander with Tajima in view of Kolpatzik to obtain the invention as specified in claims 10, 46, 56 and 66.

Regarding claim 15/10: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

20. Claims 1, 3, 5-6, 8/1, 8/3, 8/5-8/6, 36, 42, 44, 52, 54, 62 and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660) and Parker (US Patent 5,543,941).

The apparatus of claim 42 performs the method of claim 1. The apparatus of claim 36 is embodied in the apparatus of claim 42. Claims 1, 36 and 42 are therefore discussed together.

Claims 3, 44, 54 and 64 disclose the same limitations and are therefore discussed together.

Regarding claims 1, 36 and 42: Tajima discloses an apparatus (figure 2 of Tajima) comprising storage means (figure 2(6M) of Tajima) for storing the threshold matrix (column 5, lines 30-34 of Tajima); comparison means (figure 2(5) of Tajima) for comparing each value of the threshold matrix with density of each pixel of the input image (column 5, lines 14-19 of Tajima). A binary or multivalue dot pattern is output (column 5, lines 18-19 of Tajima) based on comparison results of said comparison means (column 5, lines 14-19 of Tajima), therefore an output means must be included in the apparatus.

Said threshold matrix has a size corresponding to a size smaller or substantially smaller than the pixel block (figure 3(501M) of Tajima) (figure 3 and column 5, lines 46-51 of Tajima), a dot pattern generated in the pixel block has halftone screen (meshing) properties (smooth gradation generation) at each respective gray level (column 12, lines 54-59 of Tajima), and visually unpleasing artifacts (Moiré) are not generated in the output image when the input image undergoes the gray level reproducing process (column 9, lines 48-54 of Tajima) and the produced image is output by an output device (column 10, lines 5-8 of Tajima).

Tajima does not disclose expressly that said properties that are provided are non-blue noise properties; and that said pixel block is of the standard size.

Kolpatzik discloses providing stochastic properties to the threshold matrix (array) values (column 6, lines 35-37 of Kolpatzik). The stochastic properties of the stochastic threshold matrix are designed based on trade-offs between grain and mottle of the

resultant image (column 6, lines 58-62 of Kolpatzik), and therefore not blue noise properties.

Tajima and Kolpatzik are combinable because they are from the same field of endeavor, namely halftone screen generation. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to add the stochastic screen properties taught by Kolpatzik to the halftone screen taught by Tajima. The motivation for doing so would have been to prevent image artifacts (column 7, lines 40-41 of Kolpatzik). Therefore, it would have been obvious to combine Kolpatzik with Tajima.

Tajima in view of Kolpatzik does not disclose expressly that said pixel block is of the standard size.

Parker discloses applying a mask (figure 5(502) of Parker) to a pixel block (figure 5(500) of Parker) of the standard size (256x256 pixels) (column 8, lines 19-24 of Parker).

Tajima in view of Kolpatzik is combinable with Parker because they are from the same field of endeavor, namely image processing and halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a standard size pixel block for the image data. The motivation for doing so would have been to represent 256 levels of varying distribution (column 13, lines 10-12 of Tajima) of black and white pixels on a grid (column 8, lines 15-18 of Parker). Therefore, it would have been obvious to combine Parker with Tajima in view of Kolpatzik to obtain the invention as specified in claims 1, 36 and 42.

Regarding claim 52: The threshold matrix of claim 52 is embodied in the apparatus of claim 42, the arguments of which are incorporated herein.

Regarding claim 62: Tajima discloses an apparatus (figure 2 of Tajima) comprising digital memory (figure 2(3M,3C,3Y,6M,6C,6Y) of Tajima) and a digital control circuit (figure 2(4) of Tajima) that controls digital image data processing (column 4, lines 61-64 and column 5, lines 10-19 of Tajima). The apparatus is therefore a form of computer. Since digital data is compared with threshold values (column 5, lines 14-19 of Tajima) and various digital processing is performed (column 6, lines 10-26 of Tajima), some form of software is required.

Said apparatus comprises a threshold matrix which produces a dot pattern, as disclosed in claim 52, the arguments of which are incorporated herein. Said apparatus further comprises a module for comparing (figure 2(5) of Tajima) each value of the threshold matrix with the density of each pixel of the input image (column 5, lines 14-18 of Tajima), and for controlling an output of each binary or multivalue dot pattern depending on the comparison results (column 5, lines 18-19 of Tajima).

Regarding claims 3, 44, 54 and 64: Tajima discloses that said artifacts include moiré and/or a certain repetitive pattern both having visually unpleasing contrast (column 9, lines 48-54 of Tajima).

Regarding claim 5: Tajima discloses that adjacent masks (figure 3(502M) of Tajima) are shifted along boundaries when said mask is repeatedly used and arranged two-dimensionally (figure 3 and column 5, lines 51-58 of Tajima).

Regarding claim 6: Tajima discloses a mask (halftone screen) (figure 3(502M) and column 8, lines 38-42 of Tajima) which is clearly not a quadrilateral.

Regarding claims 8/1, 8/3, 8/5 and 8/6: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

21. Claims 2, 8/2, 43, 53 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660), Parker (US Patent 5,543,941) and Rylander (US Patent 5,583,660).

Claims 2, 43, 53 and 63 disclose the same limitations and are therefore discussed together.

Regarding claims 2, 43, 53 and 63: Tajima in view of Kolpatzik and Parker does not disclose expressly that said output device has a resolution of 600 dpi or greater.

Rylander discloses an output device that has a resolution of 600 dpi or greater (column 12, lines 61-63 of Rylander).

Tajima in view of Kolpatzik and Parker is combinable with Rylander because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a high resolution output device, as taught by Rylander, to output the image data. The motivation for doing so would have been to output image data produced using a

particular fixed pattern (column 12, lines 57-60 of Rylander). Therefore, it would have been obvious to combine Rylander with Tajima in view of Kolpatzik and Parker to obtain the invention as specified in claims 2, 43, 53 and 63.

Regarding claim 8/2: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

22. Claims 4 and 8/4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660), Parker (US Patent 5,543,941) and Shimazaki (US Patent 5,832,122).

Regarding claim 4: Tajima in view of Kolpatzik and Parker does not disclose expressly that said dot pattern generated by the mask has a value equal to or greater than 0.6 dB as an average value of anisotropy at each respective gray level.

Shimazaki discloses that the threshold matrices are designed such that thresholds having close values are not positioned closely to each other, thus preventing undue localization (figures 5-7 and column 6, lines 18-21 of Shimazaki). Further, the threshold values are partially randomized (column 5, lines 54-60 of Shimazaki). The threshold values are therefore ordered in a scattered format throughout the threshold matrix, such as can be seen in figures 5-7 of Shimazaki. Since anisotropy is a measure of the sample variance over the radially averaged power spectrum, and there is a large variance in the dot pattern designed to minimize the degree of granularity (column 6,

lines 21-25 of Shimazaki), the average value of anisotropy at each respective gray level for the dot pattern is greater than 0.6 dB.

Tajima in view of Kolpatzik and Parker is combinable with Shimazaki because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the pattern of threshold matrix values taught by Shimazaki in the threshold matrices of Tajima. The motivation for doing so would have been to produce a higher quality halftone image, free of a regular pattern (column 6, lines 26-28 of Shimazaki). Therefore, it would have been obvious to combine Shimazaki with Tajima in view of Kolpatzik and Parker to obtain the invention as specified in claim 4.

Regarding claim 8/4: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

23. Claims 7 and 8/7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Kolpatzik (US Patent 5,745,660), Parker (US Patent 5,543,941) and Barton (US Patent 5,526,438).

Regarding claim 7: Tajima in view of Kolpatzik and Parker does not disclose expressly that, as a process of determining a dot distribution at each respective gray level for producing said mask, a repulsive potential is assigned to all dots constructing a determined dot pattern of a specific gray level and a new dot to determine a dot

distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials.

Barton discloses a repulsive potential (FnC) that is assigned to all dots constructing a determined dot pattern of a specific gray level (column 8, lines 45-51 of Barton) and a new dot to determine a dot distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials (column 8, lines 50-55 of Barton). For a new dot about to be placed, a cost function (FnC) is determined (column 8, lines 45-51 of Barton). Said cost function is a function of radial distance (column 8, lines 48-50 and lines 64-66 of Barton) relating candidate pixels to other dots (column 8, lines 51-54 of Barton), so said cost function is a potential function.

Tajima in view of Kolpatzik and Parker is combinable with Barton because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the repulsive potential formulation of Barton to determine the dot locations for the threshold masks. The motivation for doing so would have been to maximize dispersion and minimize visual artifacts (column 2, lines 50-53 of Barton). Therefore, it would have been obvious to combine Barton with Tajima in view of Kolpatzik and Parker to obtain the invention as specified in claim 7.

Regarding claim 8/7: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the

color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

24. Claims 17, 23/17, 48, 58 and 68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Parker (US Patent 5,543,941).

Regarding claim 48: Tajima discloses an apparatus (figure 2 of Tajima) comprising storage means (figure 2(6M) of Tajima) for storing the threshold matrix (column 5, lines 30-34 of Tajima); comparison means (figure 2(5) of Tajima) for comparing each value of the threshold matrix with density of each pixel of the input image (column 5, lines 14-19 of Tajima). A binary or multivalue dot pattern is output (column 5, lines 18-19 of Tajima) based on comparison results of said comparison means (column 5, lines 14-19 of Tajima), therefore an output means must be included in the apparatus.

Tajima further discloses that said threshold matrix produces, by itself, a dot pattern having a plurality of isolated spectra in a two-dimensional spatial frequency spectrum (column 6, lines 26-34 of Tajima).Each isolated spectra of the two-dimensional spatial frequency spectrum is located in $\mu-\nu$ space at points corresponding to m and n equal to integers (column 6, lines 26-28 of Tajima) based on a conversion equation (column 6, equation 5 of Tajima). Since halftoning is performed for multivalued image data (column 5, lines 14-19 of Tajima), said plurality of isolated spectra are provided at each respective gray level.

Tajima does not disclose expressly that said threshold matrix assigns a noise component having small low frequency components to a one-dimensional power spectrum of a dot distribution at a plurality of gray levels.

Parker discloses a halftone mask (figure 4(406) of Parker) that assigns a noise component having small low frequency components to a one-dimensional power spectrum (figure 1 and column 6, lines 51-53 of Parker) of a dot distribution at a plurality of gray levels (column 9, lines 31-37 of Parker). The filter is circularly symmetric (column 9, lines 35-36 of Parker). As can be seen from figure 1 of Parker, there are small low frequency components before the substantial rise in component values up to frequency f_g, and an absence below a certain frequency value (column 9, lines 7-12 of Parker).

Tajima and Parker are combinable because they are from the same field of endeavor, namely image processing and halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include noise components with small low frequency components, as taught by Parker, in the halftone threshold matrix taught by Tajima. The motivation for doing so would have been to eliminate disturbing artifacts in the spatial domain (column 9, lines 9-12 of Parker). Therefore, it would have been obvious to combine Parker with Tajima to obtain the invention as specified in claim 48.

Regarding claim 58: The threshold matrix of claim 58 is embodied in the apparatus of claim 48, the arguments of which are incorporated herein.

Regarding claim 68: Tajima discloses an apparatus (figure 2 of Tajima) comprising digital memory (figure 2(3M,3C,3Y,6M,6C,6Y) of Tajima) and a digital control circuit (figure 2(4) of Tajima) that controls digital image data processing (column 4, lines 61-64 and column 5, lines 10-19 of Tajima). The apparatus is therefore a form of computer. Since digital data is compared with threshold values (column 5, lines 14-19 of Tajima) and various digital processing is performed (column 6, lines 10-26 of Tajima), some form of software is required.

Said apparatus comprises a threshold matrix which produces a dot pattern, as disclosed in claim 58, the arguments of which are incorporated herein. Said apparatus further comprises a module for comparing (figure 2(5) of Tajima) each value of the threshold matrix with the density of each pixel of the input image (column 5, lines 14-18 of Tajima), and for controlling an output of each binary or multivalue dot pattern depending on the comparison results (column 5, lines 18-19 of Tajima).

Regarding claim 17: Tajima does not disclose expressly that each dot pattern generated by said mask has a noise component having small low frequency components of a one-dimensional power spectrum due to weak irregularity (perturbation) or pseudo-periodicity introduced at a plurality of gray levels.

Parker discloses a halftone mask (figure 4(406) of Parker) that assigns a noise component having small low frequency components to a one-dimensional power spectrum (figure 1 and column 6, lines 51-53 of Parker) of a dot distribution at a plurality of gray levels (column 9, lines 31-37 of Parker). The filter is circularly symmetric (column 9, lines 35-36 of Parker). As can be seen from figure 1 of Parker, there are

small low frequency components before the substantial rise in component values up to frequency f_g, and an absence below a certain frequency value (column 9, lines 7-12 of Parker).

Tajima and Parker are combinable because they are from the same field of endeavor, namely image processing and halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include noise components with small low frequency components, as taught by Parker, in the halftone threshold matrix taught by Tajima. The motivation for doing so would have been to eliminate disturbing artifacts in the spatial domain (column 9, lines 9-12 of Parker). Therefore, it would have been obvious to combine Parker with Tajima to obtain the invention as specified in claim 17.

Regarding claim 23/17: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

25. Claims 49, 59 and 69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Parker (US Patent 5,543,941) and Shimazaki (US Patent 5,832,122).

Claims 49, 59 and 69 disclose the same limitations and are therefore discussed together.

Regarding claims 49, 59 and 69: Tajima in view of Parker does not disclose expressly said threshold matrix assigns said noise component by introducing weak irregularity (perturbation) or pseudo-periodicity in the dot distribution at said plurality of gray levels.

Shimazaki discloses a dot pattern that has weak irregularity (perturbation) or pseudo-periodicity introduced at a certain gray level (column 5, lines 54-60 of Shimazaki). The threshold value of 3 is placed at one of two particular positions (figure 6(3A,3B) of Shimazaki) based on the results of a random number (column 5, lines 54-60 of Shimazaki). This would therefore produce the weak irregularity since the threshold arrays are tiled (figure 6 of Shimazaki), but the location of the threshold value of 3 is randomized between two possible locations.

Tajima in view of Parker is combinable with Shimazaki because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to introduce perturbations into the dot pattern using the method taught by Shimazaki. The motivation for doing so would have been to produce a higher quality halftone image, free of a regular pattern (column 6, lines 26-28 of Shimazaki). Therefore, it would have been obvious to combine Shimazaki with Tajima in view of Parker to obtain the invention as specified in claims 49, 59 and 69.

26. Claims 24-28, 30-33, 35/24-35/28, 35/30-35/33, 39-41, 50-51, 60-61, 70-72 and 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Shimazaki (US Patent 5,832,122).

The apparatus of claim 50 performs the method of claim 24. The apparatus of claim 39 is embodied in the apparatus of claim 50. Claims 24, 39 and 50 are therefore discussed together.

Claims 24, 40, 51, 61 and 71 disclose the same limitations and are therefore discussed together.

Claims 26 and 41 disclose the same limitations and are therefore discussed together.

Claims 30 and 74 disclose the same limitations and are therefore discussed together.

Regarding claims 24, 39 and 50: Tajima discloses an apparatus (figure 2 of Tajima) comprising storage means (figure 2(6M) of Tajima) for storing the threshold matrix (column 5, lines 30-34 of Tajima); comparison means (figure 2(5) of Tajima) for comparing each value of the threshold matrix with density of each pixel of the input image (column 5, lines 14-19 of Tajima). A binary or multivalue dot pattern is output (column 5, lines 18-19 of Tajima) based on comparison results of said comparison means (column 5, lines 14-19 of Tajima), therefore an output means must be included in the apparatus.

Tajima further discloses that said mask has the size of an array of a plurality of element masks (figure 3(502M) of Tajima), each of which are cyclically arranged (column 5, lines 30-35 of Tajima), and thus of the same size (figure 3 of Tajima).

Tajima does not disclose expressly the size of each element of the array of masks has the same size as that of a mask used in a dispersed-dot dithering method; and that the threshold matrix (mask) generates a dot pattern: (1) having at least a set of element pixel blocks, each of which corresponding to each element mask and having the same dot distribution at each respective gray level; (2) having weak irregularity (perturbation) or pseudo-periodicity introduced at a certain gray level; (3) having an equal number of dots in every element pixel block at each respective gray level; and (4) having an equal number of dots in four individual partial element pixel blocks each having a quarter size of an element pixel block at each respective (4n)th (n indicates a positive integer) gray level.

Shimazaki discloses a plurality of element masks (figure 12 and column 3, lines 50-52 of Shimazaki) wherein the size of each element of the array of masks has the same size as that of a mask used in a dispersed-dot dithering method (column 7, lines 22-29 of Shimazaki). A weighting function utilizing a visual point spread function (figure 10 of Shimazaki) is used to create a density distribution for the threshold arrays (column 7, lines 22-25 of Shimazaki) which then creates an overall density distribution (figure 12 and column 7, lines 25-29 of Shimazaki). Since a visual point spread function is used to create the density distribution (column 7, lines 22-25 of Shimazaki), the dithering (halftoning) method is therefore a dispersed-dot dithering method.

Shimazaki further discloses that said threshold matrix generates a dot pattern having at least a set of element pixel blocks (column 4, lines 46-49 of Shimazaki), each of which corresponds to each element mask and having the same dot distribution at each respective gray level (figures 5-7 and column 4, lines 46-53 of Shimazaki).

Said dot pattern has weak irregularity (perturbation) or pseudo-periodicity introduced at a certain gray level (column 5, lines 54-60 of Shimazaki). The threshold value of 3 is placed at one of two particular positions (figure 6(3A,3B) of Shimazaki) based on the results of a random number (column 5, lines 54-60 of Shimazaki). This would therefore produce the weak irregularity since the threshold arrays are tiled (figure 6 of Shimazaki), but the location of the threshold value of 3 is randomized between two possible locations.

Said dot pattern has an equal number of dots in every element pixel block at each respective gray level (column 4, lines 46-52 of Shimazaki). In the example given in figures 5-7 of Shimazaki, there are 25 pixel points which define 25 threshold values (column 4, lines 49-50 of Shimazaki) which define each element pixel block (threshold array) in the same way (column 4, lines 46-52 of Shimazaki). Therefore, for each gray level, which inherently corresponds with each threshold value, there are an equal number of dots in every element pixel block.

The threshold matrices are designed such that thresholds having close values are not positioned closely to each other, thus preventing undue localization (figures 5-7 and column 6, lines 18-21 of Shimazaki). Preventing such undue localization would therefore require, in a (4n)x(4n) pixel block (n is an integer), that said dot pattern has an

equal number of dots in four individual partial element pixel blocks each having a quarter size of an element pixel block at each respective (4n)th (n indicates a positive integer) gray level, since otherwise there would be two threshold values that are close to each other in the same partial element pixel block. Placing said two threshold values so close to each other would create undue localization and would therefore be too close and create a higher level of granularity (column 6, lines 18-23 of Shimazaki).

Tajima and Shimazaki are combinable because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply the method of creating a threshold matrix as taught by Shimazaki to the creation of the threshold matrices taught by Tajima. The motivation for doing so would have been to produce a higher quality halftone image, free of a regular pattern (column 6, lines 26-28 of Shimazaki). Therefore, it would have been obvious to combine Shimazaki with Tajima to obtain the invention as specified in claims 24, 39 and 50.

Further regarding claim 39, Tajima discloses that said threshold matrix (mask) is stored in the memory of said apparatus (column 5, lines 23-30 of Tajima) and is therefore composed by said apparatus.

Regarding claim 60: The threshold matrix of claim 60 is embodied in the apparatus of claim 50, the arguments of which are incorporated herein.

Regarding claim 70: Tajima discloses an apparatus (figure 2 of Tajima) comprising digital memory (figure 2(3M,3C,3Y,6M,6C,6Y) of Tajima) and a digital control circuit (figure 2(4) of Tajima) that controls digital image data processing (column

4, lines 61-64 and column 5, lines 10-19 of Tajima). The apparatus is therefore a form of computer. Since digital data is compared with threshold values (column 5, lines 14-19 of Tajima) and various digital processing is performed (column 6, lines 10-26 of Tajima), some form of software is required.

Said apparatus comprises a threshold matrix which produces a dot pattern, as disclosed in claim 60, the arguments of which are incorporated herein. Said apparatus further comprises a module for comparing (figure 2(5) of Tajima) each value of the threshold matrix with the density of each pixel of the input image (column 5, lines 14-18 of Tajima), and for controlling an output of each binary or multivalue dot pattern depending on the comparison results (column 5, lines 18-19 of Tajima).

Further regarding claims 25, 40, 51, 61 and 71: Shimazaki further discloses that said weak irregularity (perturbation) or pseudo-periodicity is introduced at a certain gray level equal to of higher than the first gray level (column 5, lines 54-57 of Shimazaki). The threshold value of 3 is higher than the first gray level of 1 (figure 6 and column 4, lines 55-61 of Shimazaki).

Regarding claims 26 and 41: Tajima discloses that the size of said mask (figure 3(502M) of Tajima) is smaller or substantially smaller than the size corresponding to a standard size pixel block (defined as 256x256 pixels), which can clearly be seen in figure 3 of Tajima since said mask is no larger than 6 pixels in either the horizontal or vertical directions. The mask is repeatedly arranged two-dimensionally and regularly corresponding to the entire input image (figure 3 and column 5, lines 54-58 of Tajima).

Regarding claim 27: Tajima discloses that said mask has the size of an array of a plurality of element masks (figure 3(502M) of Tajima), each of which are cyclically arranged (column 5, lines 30-35 of Tajima), and thus of the same size (figure 3 of Tajima).

Tajima does not disclose expressly the size of each element of the array of masks has the same size as that of a mask used in a dispersed-dot dithering method.

Shimazaki discloses a plurality of element masks (figure 12 and column 3, lines 50-52 of Shimazaki) wherein the size of each element of the array of masks has the same size as that of a mask used in a dispersed-dot dithering method (column 7, lines 22-29 of Shimazaki). A weighting function utilizing a visual point spread function (figure 10 of Shimazaki) is used to create a density distribution for the threshold arrays (column 7, lines 22-25 of Shimazaki) which then creates an overall density distribution (figure 12 and column 7, lines 25-29 of Shimazaki). Since a visual point spread function is used to create the density distribution (column 7, lines 22-25 of Shimazaki), the dithering (halftoning) method is therefore a dispersed-dot dithering method.

Tajima and Shimazaki are combinable because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a visual point spread function with the appropriate size element, as taught by Shimazaki. The motivation for doing so would have been to produce a higher quality halftone image, free of a regular pattern (column 6, lines 26-28 of Shimazaki). Therefore, it would have been obvious to combine Shimazaki with Tajima to obtain the invention as specified in claim 27.

Regarding claim 28: Tajima discloses that said dot pattern generated in the output image has no visually unpleasing artifacts, when the input image undergoes said gray level reproducing process (column 9,lines 48-54 of Tajima) and the produced image is outputted by an output device (column 10, lines 5-8 of Tajima).

Regarding claim 72: Tajima discloses a gray level reproducing apparatus (figure 2 of Tajima) comprising a dot pattern generated by a threshold matrix (column 5, lines 46-52 of Tajima); and visually unpleasing artifacts are not generated in the output image when the input image undergoes the gray level reproducing process (column 9, lines 48-54 of Tajima) and the produced image is outputted by an output device (column 10, lines 5-8 of Tajima). Said apparatus reduces Moiré (column 9, lines 48-54 of Tajima), which is well-known to be a visually unpleasing artifact in grayscale and color printing, and outputs the threshold values in synchronism with the multi-valued image data (column 10, lines 5-8 of Tajima), which would thus produce the output image.

Tajima does not disclose expressly that said dot pattern has an anisotropy spectrum having an average value of 3 dB or more and a maximum value of 10 dB or more at each respective gray level.

Shimazaki discloses that the threshold matrices are designed such that thresholds having close values are not positioned closely to each other, thus preventing undue localization (figures 5-7 and column 6, lines 18-21 of Shimazaki). Further, the threshold values are partially randomized (column 5, lines 54-60 of Shimazaki). The threshold values are therefore ordered in a scattered format throughout the threshold matrix, such as can be seen in figures 5-7 of Shimazaki. Since anisotropy is a measure

of the sample variance over the radially averaged power spectrum, and there is a large variance in the dot pattern that is designed to minimize the degree of granularity (column 6, lines 21-25 of Shimazaki), the anisotropy spectrum would therefore have an average value of more than 3 dB and a maximum value of more than 10 dB at each respective gray level.

Tajima and Shimazaki are combinable because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the pattern of threshold matrix values taught by Shimazaki in the threshold matrices of Tajima. The motivation for doing so would have been to produce a higher quality halftone image, free of a regular pattern (column 6, lines 26-28 of Shimazaki). Therefore, it would have been obvious to combine Shimazaki with Tajima to obtain the invention as specified in claim 72.

Regarding claims 30 and 74: Tajima discloses that said artifacts include moiré and/or a certain repetitive pattern both having visually unpleasing contrast (column 9, lines 48-54 of Tajima).

Regarding claim 31: Tajima discloses that adjacent masks (figure 3(502M) of Tajima) are shifted along boundaries when said mask is repeatedly used and arranged two-dimensionally (figure 3 and column 5, lines 51-58 of Tajima).

Regarding claim 32: Tajima discloses a mask (halftone screen) (figure 3(502M) and column 8, lines 38-42 of Tajima) which is clearly not a quadrilateral.

Regarding claim 33: Tajima does not disclose expressly that said weak irregularity (perturbation) or pseudo-periodicity is implemented by providing small pixel

blocks, each having a number of pixels equal to or smaller than a quarter (1/4) of the total number of pixels in an element pixel block, at predetermined positions in all or a part of the individual element pixel blocks, each corresponding to each element mask, and by selecting one pixel for a dot in each of said small pixel blocks.

Shimazaki discloses that said weak irregularity (perturbation) or pseudo-periodicity is implemented by providing small pixel blocks (figure 6(2x2 pixel square enclosing 3A,3B) of Shimazaki), each having a number of pixels equal to or smaller than a quarter (1/4) of the total number of pixels in an element pixel block (column 5, lines 41-46 of Shimazaki). 3A and 3B in figure 6 of Shimazaki are at an equal distance from previously established pixel points (column 5, lines 41-46 of Shimazaki). The 2x2 pixel square area surrounding them can be considered the small pixel block. Since the points, such as 3A and 3B, which are randomly selected for threshold setting (column 5, lines 54-60 of Shimazaki) are the pixels that are at an equal distance from previously established pixel points (column 5, lines 41-46 of Shimazaki), then the number of pixels for said small pixel block must be smaller than a quarter (1/4) of the total number of pixels in an element block. A section that is a quarter (1/4) of the total number of pixels in an element block would have pixels of varying distances from previously established pixels. Only comparatively few pixels could have the same said distance.

Tajima and Shimazaki are combinable because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use small regions comprising pixels that are at an equal distance from previously established pixel points to produce

said weak irregularity (perturbation) or pseudo-periodicity, as taught by Shimazaki. The motivation for doing so would have been to produce a higher quality halftone image, free of a regular pattern (column 6, lines 26-28 of Shimazaki). Therefore, it would have been obvious to combine Shimazaki with Tajima to obtain the invention as specified in claim 33.

Regarding claims 35/24-35/28 and 35/30-35/33: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

27. Claims 34 and 35/34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Shimazaki (US Patent 5,832,122) and Barton (US Patent 5,526,438).

Regarding claim 34: Tajima in view of Shimazaki does not disclose expressly that, as a process of determining a dot distribution at each respective gray level for producing said mask, a repulsive potential is assigned to all dots constructing a determined dot pattern of a specific gray level and a new dot to determine a dot distribution for a next gray level is placed at a position having the lowest repulsive potential in/within the sum of said repulsive potentials.

Barton discloses a repulsive potential (FnC) that is assigned to all dots constructing a determined dot pattern of a specific gray level (column 8, lines 45-51 of Barton) and a new dot to determine a dot distribution for a next gray level is placed at a

position having the lowest repulsive potential in/within the sum of said repulsive potentials (column 8, lines 50-55 of Barton). For a new dot about to be placed, a cost function (FnC) is determined (column 8, lines 45-51 of Barton). Said cost function is a function of radial distance (column 8, lines 48-50 and lines 64-66 of Barton) relating candidate pixels to other dots (column 8, lines 51-54 of Barton), so said cost function is a potential function.

Tajima in view of Shimazaki is combinable with Barton because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the repulsive potential formulation of Barton to determine the dot locations for the threshold masks. The motivation for doing so would have been to maximize dispersion and minimize visual artifacts (column 2, lines 50-53 of Barton). Therefore, it would have been obvious to combine Barton with Tajima in view of Shimazaki to obtain the invention as specified in claim 34.

Regarding claim 35/34: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

28. Claims 29, 35/29 and 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tajima (US Patent 5,572,600) in view of Shimazaki (US Patent 5,832,122) and Rylander (US Patent 5,583,660).

Claims 29 and 73 disclose the same limitations and are therefore discussed together.

Regarding claims 29 and 73: Tajima in view of Shimazaki does not disclose expressly that said output device has a resolution of 600 dpi or greater.

Rylander discloses an output device that has a resolution of 600 dpi or greater (column 12, lines 61-63 of Rylander).

Tajima in view of Shimazaki is combinable with Rylander because they are from the same field of endeavor, namely halftone image processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a high resolution output device, as taught by Rylander, to output the image data. The motivation for doing so would have been to output image data produced using a particular fixed pattern (column 12, lines 57-60 of Rylander). Therefore, it would have been obvious to combine Rylander with Tajima in view of Shimazaki to obtain the invention as specified in claims 29 and 73.

Regarding claim 35/29: Tajima discloses that the color image is separated into a plurality of color components (column 4, lines 64-67 of Tajima); and at least one of the color components of the color image is used as the input image (column 5, lines 10-14 of Tajima).

Conclusion

29. Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A Thompson whose telephone number is 703-305-6329. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K Moore can be reached on 703-308-7452. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

James A. Thompson
Examiner
Art Unit 2624

JAT
July 7, 2004

THOMAS D.
[redacted] LEE
PRIMARY EXAMINER